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(54) Quick disconnect fluid coupling with integral pressure relief feature.

(57) A quick disconnect fluid coupling (34) for a liquid-cooled, preprogrammed card (10) for an aircraft communication or navigation system, the coupling being made up of male and female coupling elements (30,32) which are closed to flow in the free or uncoupled state and which are open to flow when coupled. The male coupling element (30) has an integral pressure relief feature which operates in two phases. In a first phase the male coupling element remains closed to fluid flow, but accommodates an increase in fluid pressure by movement of an annular valve sleeve within in outer annular member to increase the fluid volume within the annular member. In a second phase an end of a valve member of the male coupling element is biased away from sealing engagement with an end of the annular valve sleeve by fluid pressure, against the biasing effect of a return spring which is trapped between the annular valve sleeve and a perforate annular retainer that is affixed to an opposed end of the valve member, to permit fluid to be dumped from the coupling element.

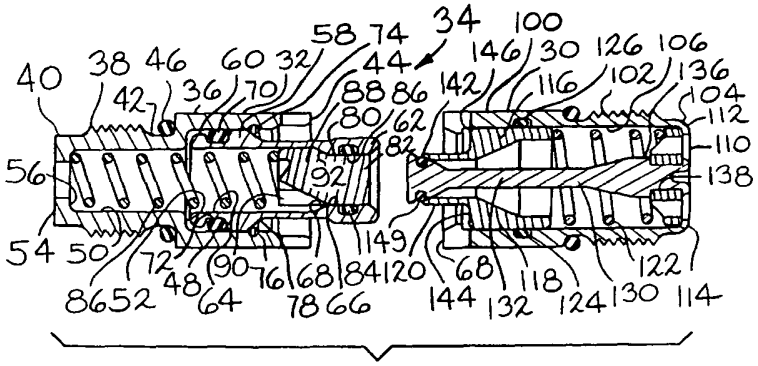

FIG. 2

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This invention relates to a quick disconnect fluid coupling which is made up of mating male and female coupling elements. More particularly, this invention relates to a quick disconnect fluid coupling which is capable of relieving an increase in pressure in a fluid line which incorporates such a coupling by accommodating an increase in the volume of fluid that is retained within the coupling.

In communication and navigation systems for civilian and military aircraft, one or more removable preprogrammed cards are inserted into the system hardware to adequately instruct the hardware in accordance with the intended destination of the flight and/or the mission to be performed by the flight. During the flight a certain amount of heat is generated within each such card by virtue of the resistance heating resulting from electrical current flowing through the electrical elements on the card, and this requires that the card be cooled during its operation. Heretofore, the cooling of the card to prevent an excessive temperature buildup therein has been accomplished partly by radiation cooling and partly by circulating air or other compressible fluid through the card. Removal of heat from such a preprogrammed card by radiation and convection cooling is somewhat limited in capacity, however, and this serves as a limitation on the amount of heat which can be generated within a card to avoid the deleterious effects of excessive temperatures.

It is possible to substantially increase the thermal capacity of a preprogrammed card for an aircraft by utilizing liquid cooling to cool the card during its normal operation. However, when a card is removed from the system, the pressure of the cooling liquid within the card will increase very substantially as a result of a very small increase in volume, for example, due to an increase in ambient temperature. Thus, an aircraft preprogrammed communication or navigation card should incorporate a pressure relief feature to avoid undesirable and possibly damaging or destructive pressure buildups within the card after the card has been removed from the system. Heretofore, the pressure relief function in each card, as well as the disconnected system, has been performed by a bleeding pressure relief valve located in the quick disconnect fluid coupling that is normally a feature of each card and each liquid cooling system. Previously, however, when the relief valve relieved pressure the fluid relieved would bleed to atmosphere causing liquid to be spilled on the surrounding electronic equipment and contracts.

According to the present invention there is provided a quick disconnect coupling for a liquid handling system with an integral pressure relief feature which is capable of eliminating the need for a bleeding pressure relief valve in such a liquid handling system, such as a liquid cooling system for cooling preprogrammed cards of the type used in aircraft communication and navigation systems. The coupling is made up of mating male and female coupling elements, and the male element incorporates an expansible internal chamber for a liquid to expand into when the pressure of the liquid exceeds a predetermined value. The expansion chamber is obtained by providing an annular valve body with an internal, coaxial sleeve which is spring biased into a position against a fixed shoulder where no liquid can flow, the coaxial sleeve and fixed shoulder being movably disposed in said annular valve body.

Accordingly, it is an object of the present invention to provide an improved quick disconnect coupling for a liquid handling system, and it is a corollary object of the present invention to provide male and female coupling elements of an improved quick disconnect coupling for such a liquid handling system. More particularly, it is an object of the present invention to provide a quick disconnect coupling for a liquid circulating system which incorporates an integral pressure relief feature therein, and it is a corollary object of the present invention to provide male and female coupling elements of such a quick disconnect coupling.

For a further understanding of the present invention and the objects thereof, attention is directed to the drawing and the following brief description thereof, to the detailed description of the preferred embodiment of the invention, and to the appended claims.

FIG. 1 is a fragmentary plan view of a preprogrammed aircraft navigation or communication card incorporating an inlet and an outlet for a liquid cooling system, each with a quick disconnect coupling in accordance with the preferred embodiment of the present invention;

FIG. 2 is an exploded view, in cross section, of the elements of a quick disconnect coupling in accordance with the preferred embodiment of the present invention in a disassembled relationship with respect to one another;

FIG. 3 is a view, similar to FIG. 2, of the quick disconnect coupling thereof with the coupling elements thereof in an assembled relationship with one another;

FIG. 4 is a view similar to FIGS. 2 and 3 of the male coupling element of the present invention with its components arranged in a first pressure relieving condition;

FIG. 5 is a view similar to FIG. 4 of the male coupling element of the present in-

vention with its components arranged in a second pressure relieving condition;

FIG. 6 is an exploded view, in perspective, of the female coupling element of the present invention; and

FIG. 7 is an exploded view, in perspective, of the male coupling element of the present invention.

As is illustrated in Fig. 1, a preprogrammed communication or navigation card 10 is detachably secured to an aircraft communication or navigation device 12, which is shown fragmentarily and schematically. The card 10 is precisely positioned from one side to another thereof by having its opposed side edges engaged in opposed tracks 14, 16 of the device 12, and by having its rear edge engaged by opposed latching devices 18, 20 which precisely position the card 10 in a front to back direction. In the position shown in Fig. 1, first and second electrical connectors 22, 24 carried by the card 10 electrically engage first and second electrical connectors 26, 28, respectively, on the device 12. The card 10 is internally liquid cooled, by means not shown, and carries spaced apart, like male coupling elements 30 which disengageably couple with spaced apart, like female coupling elements 32 on the device 12 to permit a cooling liquid, for example, water or an aqueous solution of a suitable antifreeze such as ethylene glycol, to be circulated through the card 10, and to thereby ensure proper cooling of the card 10. Each pair of the coupling elements 30 and 32, as will be hereafter described more fully, form a quick disconnect coupling 34 in accordance with the preferred embodiment of the present invention, the quick disconnect feature of the coupling 34 being important in reducing the time involved in replacing a card 1 with a similar, but somewhat differently preprogrammed card. While not a limitation on the application of the coupling of the present invention, it is to be understood that a coupling for an aircraft navigation card is quite small, for example, approximately 9.3 mm diameter X 16.7 mm mounting surface to mounting surface X 33 mm overall length, when coupled.

As is shown in Figs. 2, 3 and 6, each female coupling element 32 of a coupling 34 is made up of a metallic annular member 36 with an externally threaded portion 38 to permit an inner end 40 of the annular member 36 to be threadably secured to a fitting, not shown, within a navigation device 12. The annular member 36 further has a reduced diameter portion 42 between its end 40 and an opposed outer end 44 of the member 36, and the reduced diameter portion 42 carries a nitrile O-ring 46 to permit the annular member 36 to be sealingly inserted within a suitable opening, not shown, of the device 12.

The annular member 36 has a larger internal diameter portion 48 which extends from its outer end 44 partly towards its inner end 40, and further has a reduced internal diameter portion 50 which extends from the larger diameter portion 48 partly to the inner end 40. As shown, the larger diameter portion 48 and the smaller diameter portion 50 form an annular shoulder 52 which extends transversely of the longitudinal central axis of the annular member 36. Further, the annular member 36 has a restricted opening portion 54 extending from its inner end 40 to the smaller internal diameter portion 50, the restricted portion 54 and the smaller internal diameter portion 50 forming an annular shoulder 56 which also extends transversely of the longitudinal central axis of the annular member 36.

The female coupling element 32 also includes an annular body 58 which is slidably positioned within the larger diameter portion 48 of the annular member 36. The annular valve body 58 has an end 60 which faces toward the end 40 of the annular member 36, and which is spaced inwardly therefrom to be surrounded by the larger diameter portion 48 of the annular member 36. The annular valve body 58 further has an opposed end 62 which is positioned outwardly of the outer end 44 of the annular member 36. The annular valve body 58 has a larger internal diameter portion 64 which extends from the end 60 partly to the end 62, a smaller internal diameter portion 66 which extends from the end 62 partly to the end 60, and a frustoconically tapered surface portion 68 which is positioned between and which joins the smaller diameter portion 66 and the larger diameter portion 64. As is illustrated, for example, in Fig. 1, preferably the internal diameter of the portion 64 of the valve body 58 is substantially the same as the internal diameter portion 50 of the annular member 36 to minimize turbulence in a liquid stream flowing through the coupling element 32.

As is illustrated in Fig. 2, in the free or uncoupled state of the coupling element 32, the end 60 of the annular body 58 is spaced slightly from the shoulder 52 of the annular member 36. In the coupling of the female coupling element 32 to the male coupling element 30, the annular valve body 58 will be moved inwardly until its end 60 bottoms against the shoulder 52, at which time further inward travel of the valve body 58 within the annular member 36 will be prevented. Notwithstanding the movability of the valve body 58 within the annular member 36, as described, leakage of fluid around the valve body is prevented by providing an organic O-ring 70 therebetween, the O-ring 70 being retained in an annular recess 72 in the outer surface of the valve body 58. The O-ring 70 also permits the annular body 58 to somewhat axially

misalign itself with respect to the annular member 32 without breaking the fluid seal therebetween. This is useful in permitting the coupling of the elements 30, 32 when there is up to approximately ± 0.015 in. misalignment for a coupling of the type described.

The annular valve body 58 is positively retained within the annular member 36 by a double-ended metallic annular retainer 74 which is retained within an annular recess 76 in the larger internal diameter portion 48 of the annular member 36. The retainer 74 is positioned so that it engages a frustoconical portion 78 in the outer surface of the annular member 58 at the maximum desired outer limit of the travel of the valve body 58 relative to the annular member 36.

Fluid flow within the female coupling element 32 is controlled by a valve 80 which is slidable to and fro within the valve body 58. The valve 80 has a cylindrical outer portion 82 which fills a substantial portion of the length of the smaller diameter portion 64 of the valve body 58 when the female coupling element 32 is in its free, uncoupled state, as shown in Fig. 2. Thus, with the aid of an organic O-ring 84, which is positioned within an annular recess 86 in the smaller diameter portion 64 of the valve body 58 and which slidably engages the outer surface of the outer portion 82 of the valve 80, no fluid will flow between the valve 80 and the valve member 58 in the free or uncoupled state of the female coupling element 32. In that regard, it is noted that the valve 80 is resiliently biased toward its Fig. 2, free or uncoupled state by a coil spring 86 which is trapped between the inside of the restricted opening 54 of the annular member 36 and an enlarged end portion 88 of the valve 80. The enlarged end portion 88 is circumferentially interrupted by a plurality of longitudinally extending, spaced apart recesses 90 to permit fluid flow past the valve 80 when the coupling element 32 is away from its Fig. 2 free or uncoupled state. However, the valve 80 is prevented from exiting the valve body 58 under the influence of the spring 86 by the bottoming of a circumferentially interrupted, frustoconically shaped surface portion 92 on the outer surface of the valve 80 against the frustoconically shaped portion 68 on the inside of the valve body 58. As shown, the frustoconical surface portion 92 of the valve 80 is positioned between, and joins, the end portion 88 and the cylindrical portion 82 of the valve 80.

The male coupling element 30 includes an outer annular member 100 with an externally threaded portion 102 to permit an inner end 104 of the annular member 10 to be threadably secured to a fitting, not shown, within a card 10. The annular member 10 may be sealed with respect to an opening, not shown, in the card 10 by providing the annular member 100 with a reduced diameter portion 96 and a nitrile O-ring 98 in the reduced diameter portion 96.

The annular member 100 has a substantially uniform internal diameter 106 which extends substantially between its inner end 104 and its outer end 108, the inner end 104 itself being provided with a restricted opening 110 of short axial length by swaging or otherwise inwardly deforming a terminal portion 112 of the annular member 100. A perforate annular retainer 114 is positioned within the annular member 110 near the inner end 104, and an annular valve sleeve 116 is positioned within the annular member 110 near the outer end 108 thereof. The annular valve sleeve 116 has a large diameter end portion 118 which slidably engages the internal diameter 106 of the annular member 100 and a reduced diameter end portion 120 which extends beyond the end 68 of the annular member 100. A coil spring 122 is trapped between the annular valve sleeve 116 and the perforate annular retainer 114 to resiliently urge such elements away from one another. Further, an organic O-ring 124 is positioned in an annular recess 126 in the internal diameter 106 of the annular member 100 to prevent fluid leakage between the larger diameter portion 118 of the annular valve sleeve 116 and the internal diameter 106 of the annular member 100 as the annular valve sleeve 116 moves to and fro within the annular member 100.

The male coupling element 30 further comprises an elongate valve member 130 positioned along its longitudinal central axis. The valve member 130 has a reduced diameter central portion 132, a generally frustoconical enlarged end portion 134 which extends beyond the free end of the reduced diameter portion 120 of the annular valve sleeve 116, and an enlarged opposed end portion 130 with a stepped down free end 138 which snugly seats within an annulus in the perforate annular retainer 114 to ensure that the valve member 130 and the annular sleeve 116 will move in unison. The end portion 134 of the valve member 130 has an annular recess 140 therein, and the annular recess 140 has an organic O-ring 142 therein which seats against the free end of the reduced diameter portion 120 of the annular valve sleeve 116 in the free or uncoupled state of the male coupling element 30, as shown in Fig.2, to block all fluid flow from the outer end 68 of the annular member 100.

As is clear from Fig. 2, in the normal free or uncoupled state of the male coupling element 30 there will be a space of finite distance along the longitudinal central axis of the coupling element 30 between a radial shoulder 144 on the annular valve sleeve 116, at the juncture of the larger diameter portion 118 and the reduced diameter portion 120

thereof, and a radial shoulder 146 on the inside of the annular member 100 near the outer end 68 thereof. A condition of excess fluid pressure within the coupling element 30 will cause the annular valve sleeve 116 to move toward the free end 68 of the annular member 100, until the shoulder 144 engages the shoulder 146, a condition which is illustrated in Fig. 4. This will increase the internal volume of the coupling element 30 which is available to contain liquid, and thereby tend to relieve the condition of excessive fluid and the condition of excessive pressure within the coupling element 30 and the portions of the liquid flow system which are in communication with it. In the Fig. 4 condition of the coupling element 30, the valve number 130 will be moved to the left by virtue of the engagement of the portion 134 of the valve number 130 and the free end of the reduced diameter portion 120 of the valve sleeve 116. In turn, this will draw the perforate annular retainer 114 away from the inner end 104 of the annular member 100 by virtue of the engagement between the free end 138 of the valve number 130 and the annular retainer 114. The annular valve sleeve 116 will be free to return to its Fig. 2 position when the condition of excessive pressure is relieved, for example by the cooling of the fluid within the coupling element 30 and the line leading thereto, an event which will develop a negative pressure within the coupling element 30.

If the condition of excessive pressure within the male coupling element 30 continues beyond that which can be relieved by the movement of the valve sleeve 116 from its Fig. 2 position to its Fig. 4 position, the pressure will tend to move the valve member 130 and the annular retainer 114 further to the left, thereby partly compressing the spring 122 and breaking the seal between the O-ring 142 and the free end of the reduced diameter portion 120 of the valve sleeve 116. This condition, which is illustrated in Fig. 5, will permit liquid within the coupling element 30 to be dumped, until such time as the liquid pressure within the coupling element falls below that required to overcome the biasing effect of the spring 122, at which time the spring 122 will tend to move the annular retainer 114 to the right, to its Fig. 4 position, which will reestablish a seal between the O-ring 142 and the free end of the reduced diameter portion 120 of the valve sleeve 116.

As is clear from a comparison of Figs. 2 and 3, a flow path for liquid from the coupling element 30 to the coupling element 32 is established when the coupling elements 30, 32 are connected, by the movement of the annular valve sleeve 116 of the coupling element 30 to the right, against the biasing effect of the spring 122, by virtue of its engagement with the end 62 of the annular valve body 58 of the coupling element 30, and by the movement of the valve 80 of the coupling element 32 to the left, against the biasing effect of the spring 86, by virtue of the engagement of the free end of the valve 80 by the end portion 34 of the valve member 130. In this condition of the coupling elements 32, 30, the O-ring 84 of the coupling element 32 will sealingly engage the outer surface of the reduced diameter portion 120 of the annular valve sleeve 116 to prevent fluid flow therebetween.

Although the best mode contemplated by the inventor(s) for carrying out the present invention as of the filing date hereof has been shown and described herein, it will be apparent to those skilled in the art that suitable modifications, variations, and equivalents may be made without departing from the scope of the invention, such scope being limited solely by the terms of the following claims.

Claims

1. A coupling element for a fluid line quick disconnect coupling, said coupling element comprising:

an annular member having a first end with a restricted opening and a second end with a restricted opening;

a perforate retainer, said perforate retainer being positioned within said annular member and being slidable between first and second positions, said first position of said perforate retainer being adjacent said first end of said annular member and said second position of said perforate retainer being positioned inwardly of said first end of said annular member;

an annular valve sleeve, said annular valve sleeve having a larger diameter portion which is slidably positioned within said annular member, a reduced diameter portion which extends outwardly from said annular member through said first end, and a generally transversely extending shoulder at a juncture between said larger diameter portion and said smaller diameter portion, said annular valve sleeve being slidable between a first position corresponding to the first position of said perforate retainer in which said shoulder is spaced inwardly of the restricted opening at the second end of said annular member and a second position corresponding to the second position of said perforate retainer in which the shoulder of said annular valve sleeve engages the restricted opening at the second end of said annular member;

spring means trapped between said perforate annular retainer and said annular valve spring for resiliently maintaining a predetermined spacing between said perforate annular retainer and said annular valve sleeve; and

an elongate valve member having a first end affixed to said perforate retainer and a second end extending beyond said reduced diameter portion of said annular valve sleeve, said elongate valve member normally sealingly engaging a free end of said reduced diameter portion in a free or uncoupled condition of said coupling element to prevent fluid flow through said reduced diameter portion.

2. A coupling element according to Claim 1 and further comprising:

O-ring sealing means between the outside of said larger diameter portion of said annular valve sleeve and the inside of said annular member to prevent fluid flow between said annular valve sleeve and said annular member.

3. A coupling element according to Claim 2 wherein said second end of said elongate valve member has an enlarged portion with an inwardly tapering outer surface, and further comprising:

second O-ring sealing means carried by said enlarged portion, said O-ring sealing means normally sealingly engaging a free end of said reduced diameter portion of said annular valve member in the free or uncoupled condition of said coupling element.

4. A coupling element according to Claim 3 wherein said perforate retainer is further slidable between the second position and a third position under a condition of excessive fluid pressure within said annular member, said third position of said perforate retainer being positioned inwardly of said second position of said annular retainer, said perforate retainer, in its third position, partly collapsing the length of the spring means relative to the length of the spring means when the perforate retainer is in its second position, the second O-ring sealing means being out of sealing engagement with the free end of said reduced portion of said annular valve member in the free or uncoupled condition of said coupling element when said perforate retainer is in its third position to permit dumping of fluid from within said annular member and thereby relieve the condition of excessive fluid pressure.

5. A coupling element for a fluid line quick disconnect coupling, said coupling element comprising:

a first annular member, said first annular member having a larger diameter portion extending inwardly from a first end thereof, a reduced diameter portion extending substantially from a second end thereof to said larger diameter portion, a first transversely extending annular shoulder at a juncture between said larger diameter portion and said reduced diameter portion, said first annular shoulder extending outwardly from said reduced diameter portion, and a second transversely extending annular shoulder adjacent said second end thereof, said second annular shoulder extending inwardly from said reduced diameter portion;

an annular valve body positioned within said larger diameter portion of said first annular member, said annular valve body being slidable within said first annular member between a first position where an end of said annular valve body is out of engagement with said first shoulder and a second position where the end of said annular valve body is in engagement with said first shoulder, said annular valve body further having an opposed end which extends outwardly beyond said first end of said first annular member, said annular valve body further having on its inside surface, between its end and its opposed end, a surface position which tapers inwardly as it extends toward said opposed end;

a valve, said valve having a first end and an opposed end, said first end being generally cylindrical, said opposed end being larger in radial extent than said first end and having longitudinally extending slot means therethrough, said valve further having a tapered surface between said first end and said opposed end, said tapered surface tapering inwardly as it extends toward said first end, said valve being movable within said annular valve body between a first position where said first end of said valve is positioned within said opposed end of said valve body and substantially fills said opposed end of said valve body, and a second position wherein said first end is positioned inwardly of said opposed end of said valve body, said tapered surface of said valve engaging said surface portion of said annular valve body in the first position of the valve; and

spring means trapped between said second annular shoulder of said first annular member and said opposed end of said valve, said spring means resiliently urging said valve to the first position of said valve.

6. A coupling element according to Claim 5 wherein the annular valve body has an external diameter which is substantially equal to and coaxial with an internal diameter of the reduced diameter portion of said first annular member.

7. A coupling element according to Claim 6 and further comprising:

O-ring sealing means between the outside of the first end of said valve and the inside of the annular valve body when said valve is in is first position.

8. A coupling element according to Claim 7 and further comprising:

annular recess means on the inside of the annular valve body, said annular recess means engaging and retaining said O-ring sealing means.

9. A coupling element according to Claim 5 wherein said slot means comprises a circumferentially spaced part plurality of longitudinally extending slots in said opposed end of said valve.

10. A coupling for a fluid line, said coupling comprising first and second coupling elements coupled together to permit fluid to flow in series through said coupling elements, said first coupling element comprising:

a first annular member, said first annular member having a larger diameter portion extending inwardly from a first end thereof, a reduced diameter portion extending substantially from a second end thereof to said larger diameter portion, a first transversely extending annular shoulder at a juncture between said larger diameter portion and said reduced diameter portion, said first annular shoulder extending outwardly from said reduced diameter portion, and a second transversely extending annular shoulder adjacent said second end thereof said second annular shoulder extending inwardly from said reduced diameter portion;

an annular valve body positioned within said larger diameter portion of said first annular member, said annular valve body being slidable within said first annular member and being in a position where an end of said annular valve body is in engagement with said first shoulder, said annular valve body further having an opposed end which extends outwardly beyond said first end of said first annular member, said annular valve body further having on its inside surface, between its end and its opposed end, a surface portion which tapers inwardly as it extends toward said opposed end;

a valve, said valve having a first end and an opposed end, said first end being generally cylindrical, said opposed end being larger in radial extent than said first end and having longitudinally extending slot means extending therethrough, said valve further having a tapered surface between said first end and said opposed end, said tapered surface tapering inwardly as it extends toward said first end, said valve being movable within said annular valve body and being in a position where said first end is positioned inwardly of said opposed end of said valve body, said tapered surface of said valve being out of engagement with said surface portion of said annular valve body in said first position of the valve; and

spring means trapped between said second annular shoulder of said first annular member and said opposed end of said valve, said spring meas resiliently urging said valve toward said second coupling element;

said second coupling element comprising:

a second annular member having a first end with a restricted opening and a second end with a restricted opening, said second end of said second annular member being adjacent to said first end of said first annular member;

a perforate retainer, said perforate retainer being slidably positioned within said second annular member, said perforate retainer being adjacent said first end of said second annular member;

an annular valve sleeve, said annular valve sleeve having a larger diameter portion which is slidably positioned within said annular member, a reduced diameter portion which extends from said larger diameter portion toward said second end of said second annular member and a generally transversely extending shoulder at a juncture between said larger diameter portion and said smaller diameter portion, said shoulder of said annular valve sleeve being in engagement with a free end of said annular valve body of said first coupling element;

spring means trapped between said perforate annular retainer and said annular valve sleeve for resiliently urging said annular valve sleeve toward said first coupling element; and

an elongate valve member having a first end affixed to said perforate retainer and a second end extending beyond said reduced diameter portion of said annular valve sleeve, said elongate valve member engaging a free end of said first end of said valve to keep said first end of said valve from blocking fluid flow through said opposed end of said annular valve body.

11. A coupling according to Claim 10 wherein said second coupling element further comprises:

O-ring sealing means between the outside of said larger diameter portion of said annular valve sleeve and the inside of said second

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(58) Field of search
F2G
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(54) **Disconnectible pipe couplings**

(57) A coupling member 1 includes a valve body (3a, 3b, 3c) which is fixed, and a longitudingally-displaceable sleeve (4) which in a sealing position is designed to seal against the valve body via a sealing element (7) arranged on the latter. The sealing element (7) is arranged in the valve body in such a way that in the sealing position the sleeve extends past the sealing element. The pressure medium within the valve body acts on the sealing element and thus contributes towards effective mutual sealing between the valve body and the sleeve (4). On insertion of a male coupling member 2 into the coupling member 1 the sleeve 4 is pushed back by engagement between a surface 2a in the member 2 and a shoulder 4c on the sleeve 4.

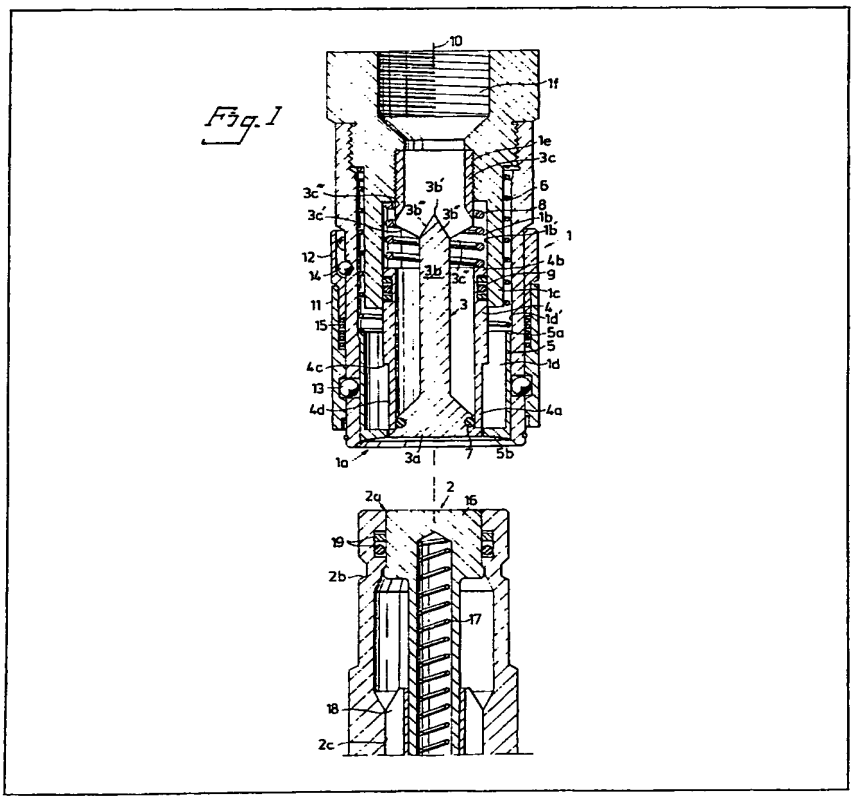

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Fig. 1

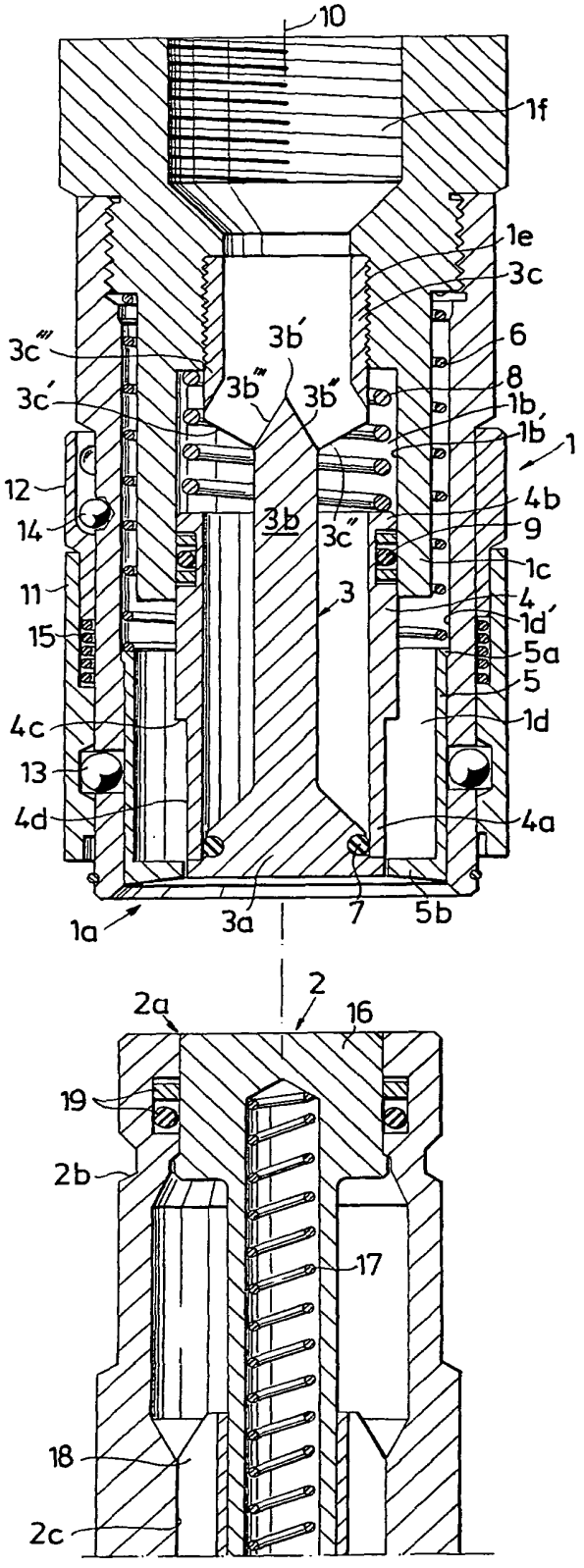

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Fig. 2

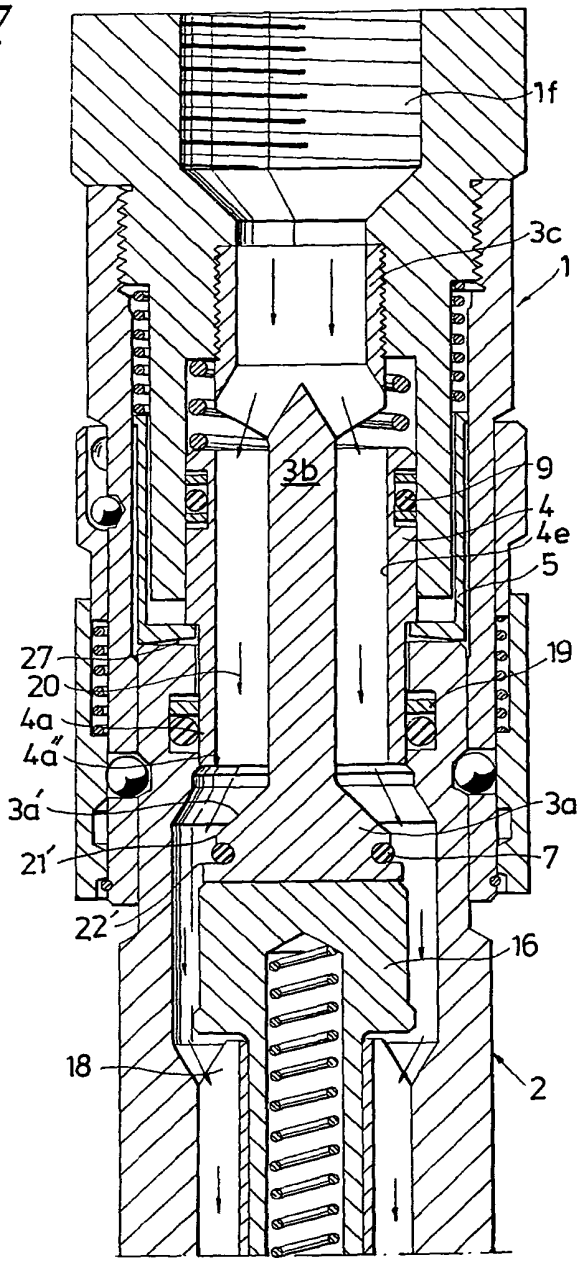

Fig. 3

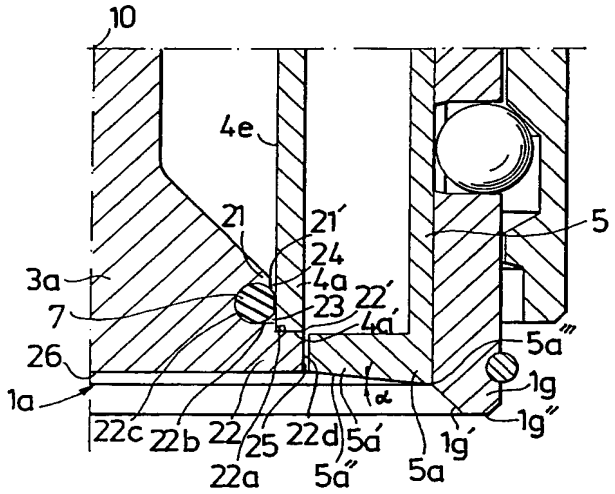
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Fig. 4

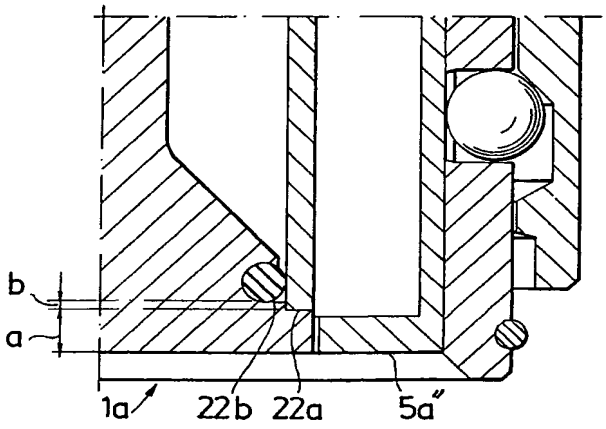
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Fig. 5

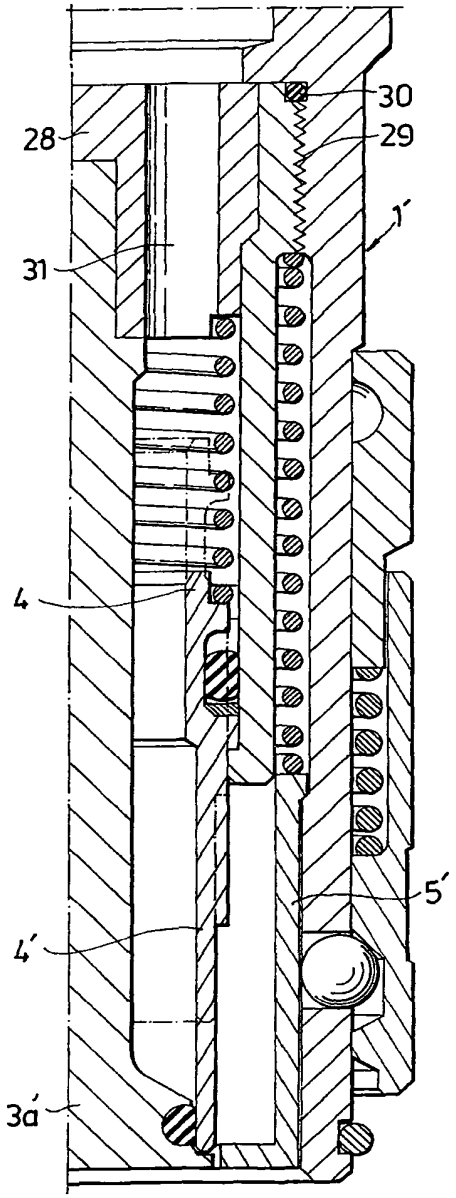
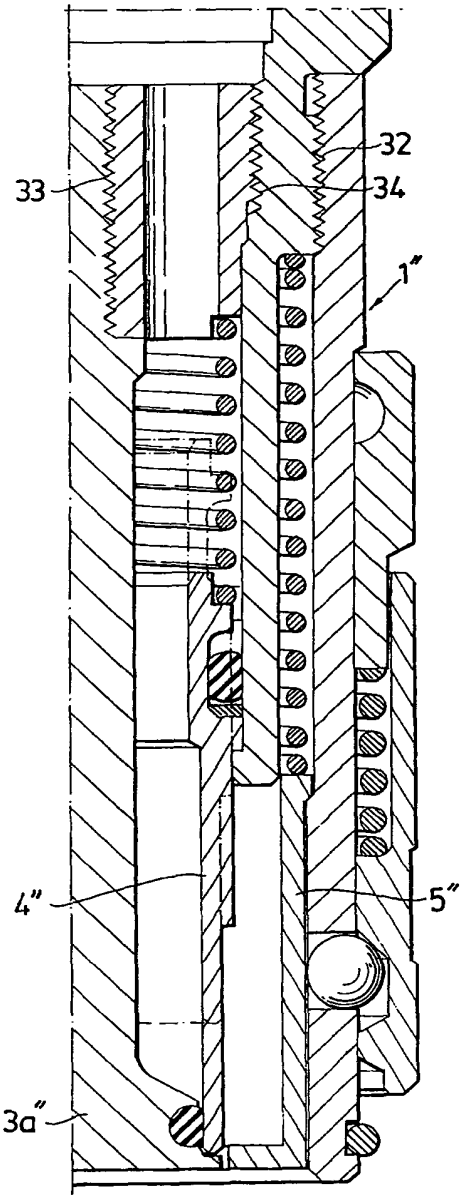


Fig. 6



SPECIFICATION

Coupling member

The present invention relates to coupling members of the kind which comprise a valve body, fixed or movably arranged, and a longitudinally-displaceable sleeve which in a sealing position is designed to seal against the valve body via a sealing element arranged on the latter. Hence the invention is aimed at utilisation, inter alia, on "environmental couplings" or non-spill couplings where the said coupling components are, by means of a rapid coupling function, capable of interacting with another coupling member. The connected medium can comprise hydraulic oil.

The method is already known of designing the said environmental couplings as "flat nose couplings", which are characterised in that both coupling members are provided with nose sections with essentially plane frontal surfaces which can easily be wiped dry prior to the coupling members being connected together. In such a non-spill flat nose coupling the said sleeve is incorporated in the form of an inner sleeve which is spring-actuated in one direction, and in its other direction it can be displaced by means of the second coupling component against the said spring action. Here it is important that the sleeve in the position in which it is not affected by the second coupling member can adopt a sealing position by means of the said spring action and possibly pressure from a medium which is present in the coupling member which is thus closed. In this connection the sealing arrangement should be such that the force when the coupling members are joined together does not become excessive. In the known type of flat nose couplings a covering sleeve arrangement is also employed which is displaceable relative to the said sleeve and valve body. The said sealing covering sleeve arrangement exhibits an external surface which forms part of the essentially plane frontal surface of the coupling member.

With the relevant types of couplings it is important to be able to bring about a sealing arrangement for the inner sleeve and the valve body which provides the necessary high standard of sealing, whilst at the same time the components involved are constructed in such a way that manufacturing costs can be kept at a relatively low level.

It is also important that the different portions of the coupling be designed so that dirt and extraneous particles are prevented from entering at the frontal surfaces of the coupling members concerned.

An object of the present invention is to provide an arrangement which, inter alia, solves the above-mentioned problem and the main characteristic of the invention is that the valve body is designed with a supporting device which is assigned to the said sleeve, which exhibits a supporting surface which is plane and extends essentially radially, against which the sleeve is designed to rest in the said sealing position. The valve body is furthermore provided with a sealing element so that in the said sealing position the sleeve extends right past the sealing element and together with the valve body and its supporting device forms an essentially closed chamber for the sealing element. Via a gap which faces away from the supporting device the chamber is connected with a medium pressure, which is sealed off by the coupling member, which is effective on the sealing element and by this means contributes towards effective mutual sealing of the valve body and the sleeve by means of the sealing element.

In further embodiments of the concept of the present invention it is proposed inter alia, to provide a flap, capable of being folded down, and forming part of the valve body, which in the rolled down position fixes the sealing element to the valve body. The said flap is furthermore so arranged that the sealing element is given a protected position with respect to the medium pressure. Furthermore more comprehensive details are given of the construction of the supporting device and the inner sleeve so as to form a suitable chamber which fundamentally exceeds the volume of the sealing element and arranged in such a way that effective deformation of the sealing element is brought about, which is to some extent pressed directly axially against the radial top surface of the supporting device, and to some extent directly radially against the inner wall of the sleeve, whereby reliable sealing of the essentially radial gap between the valve body and sleeve is achieved.

In connection with the said further embodiments, improvements are also proposed in connection with the design of the inner sleeve and of the valve body which become feasible thanks to the invention. In addition details are given as to how the supporting device is to be arranged in relation to the opposing sections on a further sleeve, in the form of a covering sleeve, which is located outside and capable of movement in relation both to the inner sleeve and the valve body. The latter-mentioned components can in this connection form part of a flat-nosed environmental coupling arranged with rapid coupling function for the two coupling members.

Nevertheless the new coupling can be regarded as being characterised mainly by what is stated in the descriptive portions of the following patent claim 1.

The proposals above provide an effective sealing arrangement with technical/economic advantages for, inter alia, the above mentioned types of couplings, the other components of which can - thanks to the present invention - also be given an appropriate and economic design.

Thanks to the new arrangement there is only one gap in the essentially plane frontal surface on the coupling component concerned, which in an excellent manner, also reduces the risk of dirt penetration in the media system. Furthermore the sealing element is given a location which is protected from the said dirt and extraneous particles.

The sealing arrangement functions both at low and high pressure, the latter for example being capable of exceeding 30 Mpa. In the latter case the sealing arrangement and sleeve are so arranged that the pressure of the actual medium affects the sealing element and, by exerting purely axial and radial forces on this, contributes to effective sealing.

Thanks to the proposals above, I avoid the sleeve resting on the supporting device via slanting sealing surfaces which require relatively high manufacturing precision and considerable thickness of the material in the sleeve.

A proposed embodiment of an arrangement which exhibits the characteristics significant of the present invention will be described in the following with simultaneous reference to the attached drawings in which:

Figure 1 shows in longitudinal section two quick coupling members designed for hydraulic oil in the de-coupled position, the said quick coupling members forming together a non-spill environmental coupling with essentially plane frontal surfaces on the coupling members.

Figure 2 shows in longitudinal section the coupling members as in Figure 1 in a fully coupled position, whereby coupling together takes place with the aid of automatic coupling components on the coupling members.

Figure 3 shows enlarged and in longitudinal section portions of the frontal section of the first coupling component (female portion) of the coupling members in Figure 1 and 2.

Figure 4 shows in longitudinal section a modified embodiment of the components shown in Figure 3.

Figure 5 shows in longitudinal section one half of the female coupling member in a further modified embodiment, and

Figure 6 shows in longitudinal section one half of the female coupling member in an embodiment modified over all the other embodiments.

The coupling as shown in Figure 1 and 2 comprises first coupling member 1 and a second coupling member 2, whereby coupling member 1 comprises a female portion and coupling 2 is a male portion.

The coupling forms a "flat nose coupling" where the respective coupling members are made with an essentially plane frontal surface 1a and 2a respectively.

Couplings of this type are as such assumed to be well known, so that only a brief account will be given here of their fundamental construction and function. The first coupling member 1 includes a valve body, of the "shank design", which is located firmly and coaxially relevant to the first coupling member inside the first coupling member. An inner sleeve 4 and an outer sleeve or covering sleeve 5 are arranged so that they can be displaced relative to the valve body 3. The outer sleeve 5 is angled at one end and at its other end is subject to spring action by a spiral spring 6 which tries to keep the outer sleeve pressed against the said frontal surface 1a.

The valve body includes inter alia a valve head 3a which carries a seal 7- and on its first end sections 4a the inner sleeve is designed, when in a sealing position as shown in Figure 1, to interact with the said valve head 3a and the sealing ring 7, so that a sealing function is obtained between the sleeve 4 and the valve head 3 with the aid of the seal. A spring 8, preferably a helical spring, is effective against the other end portions of the sleeve 4, more precisely the end edge 4b, and tries to maintain the inner sleeve in the sealing position. At its upper end sections the inner sleeve carries a further seal 9 which comprises a "back-up" seal of a type which as such is well known. The sleeve 1 is mounted in a first recess 1b in the first recess 1b in the first coupling member, whereby the sleeve receives guidance on a first internal wall 1b' of the said recess. The seal between the sleeve 4 and the said inner wall 1b' is provided by means of the said seal 9. The said first chamber comprises a partial chamber in the first coupling member and is provided with a portion 1c which extends axially inside the first coupling member.

The outer sleeve rests in the second chamber 1d in the first coupling member, whereby the wall of the chamber is designated 1d'. The outer surface rests against this inner wall 1d' and the outer extreme position of the outer sleeve is governed by a lip 5a thereon. The angled portion 5b of the outer sleeve is designed to be capable of interacting with frontal portions of the second coupling member, with the aid of which the outer sleeve is thus capable of insertion in the first coupling. With a given degree of insertion the outer sleeve interacts with the inner sleeve 4 and entrains this. This entrainment occurs as a result of the interaction between the free end of the angled portion 5a and a shoulder 4c, which is provided by means of a recess 4d on the inner sleeve.

The valve body is also provided with a shank portion 3b which extends coaxially in relation to the inner sleeve and up to or beyond the upper end surface 4b of the latter. The end of the shank which faces towards the valve head 3a is linked with a flow distribution housing 3a which is similarly part of the valve body and which is provided with an external thread, which can be screwed into a corresponding internal thread 1e in the coupling component 1.

In the flow distribution housing the flow which arrives from the incoming chamber 1f of the coupling component is distributed to a number of outlets 3c', 3c", which can for example be four in number and uniformly distributed around the central axis 10 of the coupling member. The exit holes are furthermore sloping and the shank is terminated in the housing by a tip 3b' which projects into the housing and by sloping surfaces 3b" and 3b'". From the said outlets the flow is led down into chamber 1b and into the sleeve 4. With the sleeve in its sealing position the pressure in the first coupling member is inter alia effective on the upper end surface 4b of the inner sleeve. The medium is sealed off as outlined above by means of the seals 7 and 9.

The first coupling member also incorporates outer locking sleeves 11 and 12, which as such are well known, and which with the aid of locking balls 13 and 14 and a further spring 15 are arranged to bring about in a known manner an automatic quick coupling function when coupling members 1 and 2 are joined together. The second coupling component is for this purpose provided with a radial outer groove 2b, via which interaction occurs with the locking balls 13 in the first coupling member.

The second coupling member 2 is entirely prior art and exhibits an axially displaceable valve body 16 which by means of a spring 17 is pressed against the

front portions of the coupling member. The valve body 16 is coaxially mounted in a cross mounting 18 which rests against the inner wall 2c of coupling member 2. The valve body 16 is expanded at its free end and is sealed by means of a seal 19 of the "back-up" type.

Figure 2 shows inter alia how the flow path is formed through the connected members 1 and 2, whereby the flow medium is indicated by 20. Even if the flow as such can be imagined as being led in the opposite direction, the flow path 20 in the present case leads from chamber 1f, through the flow distribution housing 3c to the chamber between the inner sleeve 4 and the shank 3b, then on the outside of valve heads 3a and 16, and down and through the wings 18 of the cross mounting. With the position for the medium thus open, sealing of the flow takes place by means of the seal 9 and seal 19 which seal against the outside of the inner sleeve 4 at the recess 4d.

The diagram shows in greater detail, inter alia, a flap 21 arranged in the material of the valve head 3a, which adopts a rolled-down position over the sealing element 7 so that the sealing element is reliably fastened to the valve head. The valve head 3a also carries a supporting device 22 extending radially which supports a supporting flange, which is essentially radial, or supporting surface 22a, against which the sleeve end 4a is arranged to rest with its end edge surface 4a' which extends straight and parallel with the surface 22a. The outer tip of the rolled-down flat 21 and the outer tip of the supporting device 22 are denoted by 21' and 22' respectively.

If we again study diagram 2 the said outer tips 21' and 22' are also indicated here. This shows that an imaginary straight line drawn between the said tips extends right outside the sealing element, or essentially in connection with the tangents of the sealing element which are parallel with the straight line. This means that the sealing element is provided with an excellently protected position for the flow of the medium which is deflected towards the top surface 3a' of the valve head 3a. If for example the medium comprises hydraulic oil, then no extraneous particles present in the hydraulic oil can have a harmful effect on the sealing element.

Diagram 2 also shows that the lower portions 4a of the inner sleeve exhibit an internal chamfer for 4a" which facilitates the guidance of the sleeve to the sealing position via the tip of the flap 21' which thereby also functions as the guidance device for the inner sleeve.

The inner sleeve is simple in construction with a straight inner wall 4e and a straight outer wall which is reduced in section one step with the straight recess 4d (Figure 1).

The supporting device 22 shown in Figure 3 is relatively strong and is between 0.5 - 5 mm in thickness, which dependent on coupling type and/or coupling size. The straight radial upper surface 22a is height levelled at the location of the sealing ring 7, whereby a surface which is displaced in parallel in relation to the surface 22a is denoted by 22b. The latter partial surface is directly adjacent to the inner wall 4e of the inner sleeve, when the inner sleeve rests on the supporting device. The said surface 22b changes into a curved circular partial surface 22c which is terminated at the top by the said rolled-down flap 21. The supporting device is essentially the same thickness as, preferably somewhat thicker, than the free end 5a' of the angled portion 5a of the outer sleeve 5.

An essentially closed chamber 23 is thus formed for the sealing element 7 with the partial surfaces 22b and 22c, the rolled down flap 21 and the inner wall 4e. The said closed chamber communicates with the inner chamber of the sleeve 4 via a gap 24, facing away from the supporting device 22, which gap is between 0,1 and 0,2 mm. In the closed position of the sleeve, the inner wall 4e is guided by the axial surface which connects surfaces 22a and 22b, and the gap between the sleeve and last mentioned surfaces is right-angled, i.e. the gap between the axial surface and 22a forms a "L".

The volume of the chamber 23 exceeds the volume of the sealing element 7 and the sealing element projects beyond the flap 21 in a radial direction by 2/5 - 1/10 of its section which is circular in the present case. The degree of projection is preferably about 1/5.

As a result of the step-shaped radial sealing surface 22a and 22b, where the end surface 4a' on the sleeve rests against the surface 22a and surface 22b originates from the inner surface 4e of the sleeve, an effective sealing function is obtained even with high pressure of the medium which affects the sealing element in the axial direction via the gap 24. The sealing element is pressed axially against the surface 22b by the pressure and the radial forces generated in the sealing element are effective against the inner surface 4e of the sleeve. This provides an effective sealing function and the sleeve 4 can be dimensioned so that its sleeve end is made of relatively thin material. At low medium pressures the spring 8 ensures that the sleeve is pressed against the supporting surface 22a so that a required seal is obtained via the inner wall 4e of the sleeve. The pressure of the medium is effective on the end surface 4b of the sleeve and at high pressure this together with the spring ensures adequate contact on the part of the sleeve.

The said free end 5a of the angled portion 5c of the outer sleeve 5 is opposite to the free end surface 22d of the supporting device, the opposite surfaces having essentially the same height and being arranged with an intervening gap of 0, 1 - 0,5 mm. The essentially plane lower surface 5a" of the angled portion, the free end of which connects with the plane lower surface of the valve head 3a, is also sloping, in as much as it slopes from the outer edge inwards/upwards. An angle of slope α is thus equal to 0 - 15°, preferably about 5° in the case illustrated.

The outer edge 5a''' of the radial portion of 5a connects with a chamfer 1g' on the ball holder 1b arranged on the first coupling member, which chamfer is about 45° in relation to the axis 10 and extends along ca half up to 2/3 of the material in the ball holder 1g. The front surface of the first coupling component is formed in this way by straight and mutually interrupted partial surfaces 26 (on the valve